

maximum duration of behavioural oestrus, 4 days. No changes in the pouch area similar to those occurring in *A. stuartii* during oestrus (Woolley, 1966a) were observed. About the time when mating occurred, body weight declined. Changes were first seen in the pouch area 30 to 52 days after the last copulation. The pouch area gradually enlarged and the sides thickened, and the pouch skin developed a granular appearance. Clear secretion, which accumulates around the base of the nipples of *A. stuartii* when birth of the young is imminent, or at the end of pseudopregnancy (Woolley, 1966a, b), appeared 44 to 53 days after the last copulation. Figure 2 shows the body weight, the occurrence of matings, the day when development of the pouch area was first observed and the day of appearance of clear secretion in the pouch of five females during the breeding period. The day of appearance of clear secretion in each of the females has been synchronised to simplify comparison of events. The periods during which a male was caged with each of the females are also shown.

None of the four females which were observed to mate produced pouch young and no young were found in the nesting material. Either the females failed to conceive, or young were lost during pregnancy or at parturition. Three of these four females were killed within 6 days of the appearance of clear secretion in the pouch and one ovary from each was sectioned. That ovulation had occurred was shown by the presence of corpora lutea in each ovary.

One female which was not observed to mate also showed development of the pouch area followed by the appearance of clear secretion. It can be seen from Figure 2 that this female was caged alone during the period when, from the time-relationships between mating and appearance of clear secretion in three of the other females, oestrus most probably occurred. It therefore seems likely that mating did not occur. If so, ovulation occurs spontaneously, for corpora lutea were present in the ovary.

Summary and General Conclusions

The dibbler appears to have only one breeding season per year. Unlike all other species of *Antechinus* so far investigated, which breed in winter or spring (Woolley, 1966, Wakefield and Warneke, 1967, and Taylor and Horner, 1970), the dibbler breeds in autumn. In the laboratory males showed spermatorrhea from early January to late April and matings occurred in March and April. No information is available on the occurrence of spermatorrhea in males in the field. There is an indication that breeding in the field occurs at approximately the

same time of the year as in the laboratory, since wild-caught female 3 gave birth to young in April.

No young resulted from the matings which occurred in the laboratory. However, if the appearance of clear secretion around the nipples can be equated with the end of pregnancy, or pseudopregnancy (as in *A. stuartii*), an estimate of the gestation period in *A. apicalis* can be made. The period from the end of behavioural oestrus to the appearance of clear secretion varied from 44 to 53 days in four females.

The young of female 3 were dependent on the mother for approximately 4 months. They reached sexual maturity in the breeding season of the year following that in which they were born, when they were about 10 or 11 months old.

Females may breed in more than one breeding season. Female 3 appeared to have reared a litter before capture in 1967, and another litter was reared in captivity.

The evidence available suggests that males also may breed in more than one breeding season. Male 1 was probably reproductively mature in 1967 and was coming into breeding condition again early in 1968.

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References

- Marlow, B. J. (1961).—Reproductive behaviour of the marsupial mouse, *Antechinus flavipes* (Waterhouse) (Marsupialia) and the development of the pouch young. *Aust. J. Zool.* 9: 203-218.
- Maccombe, M. K. (1967).—The rediscovery after 83 years of the dibbler *Antechinus apicalis* (Marsupialia, Dasyuridae). *W. Aust. Nat.* 10: 103-111.
- Ride, W. D. L. (1970).—“A Guide to the Native Mammals of Australia.” Oxford University Press, Melbourne.
- Taylor, J. M. and B. E. Horner (1970).—Gonadal activity in the marsupial mouse, *Antechinus bellus*, with notes on other species of the genus (Marsupialia: Dasyuridae). *J. Mammal.* 51: 659-668.
- Wakefield, N. A. and R. M. Warneke (1967).—Some revision in *Antechinus* (Marsupialia). 2 *Victorian Nat.* 84: 69-99.
- Woolley, P. (1966a).—Reproduction in *Antechinus* spp. and other dasyurid marsupials. *Symp. zool. Soc. Lond.* no. 15: 281-294.
- Woolley, P. (1966b).—Reproductive biology of *Antechinus stuartii* Macleay (Marsupialia: Dasyuridae). Ph.D. thesis, Australian National University, Canberra.

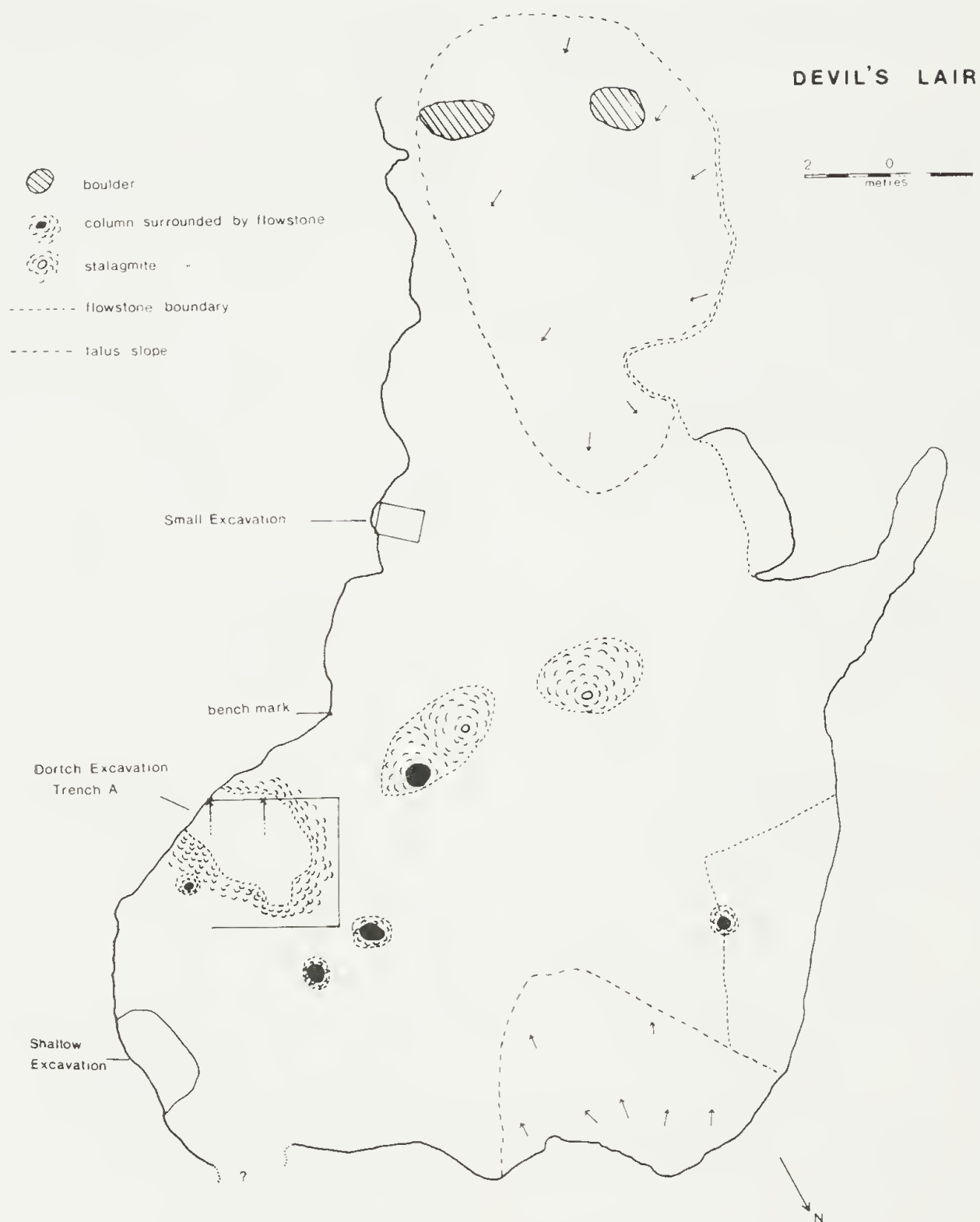


Figure 1.—Floor plan of Devil's Lair, Cave W 61, Cape Leeuwin-Cape Naturaliste region, Western Australia.

DEVIL'S LAIR Trench A1

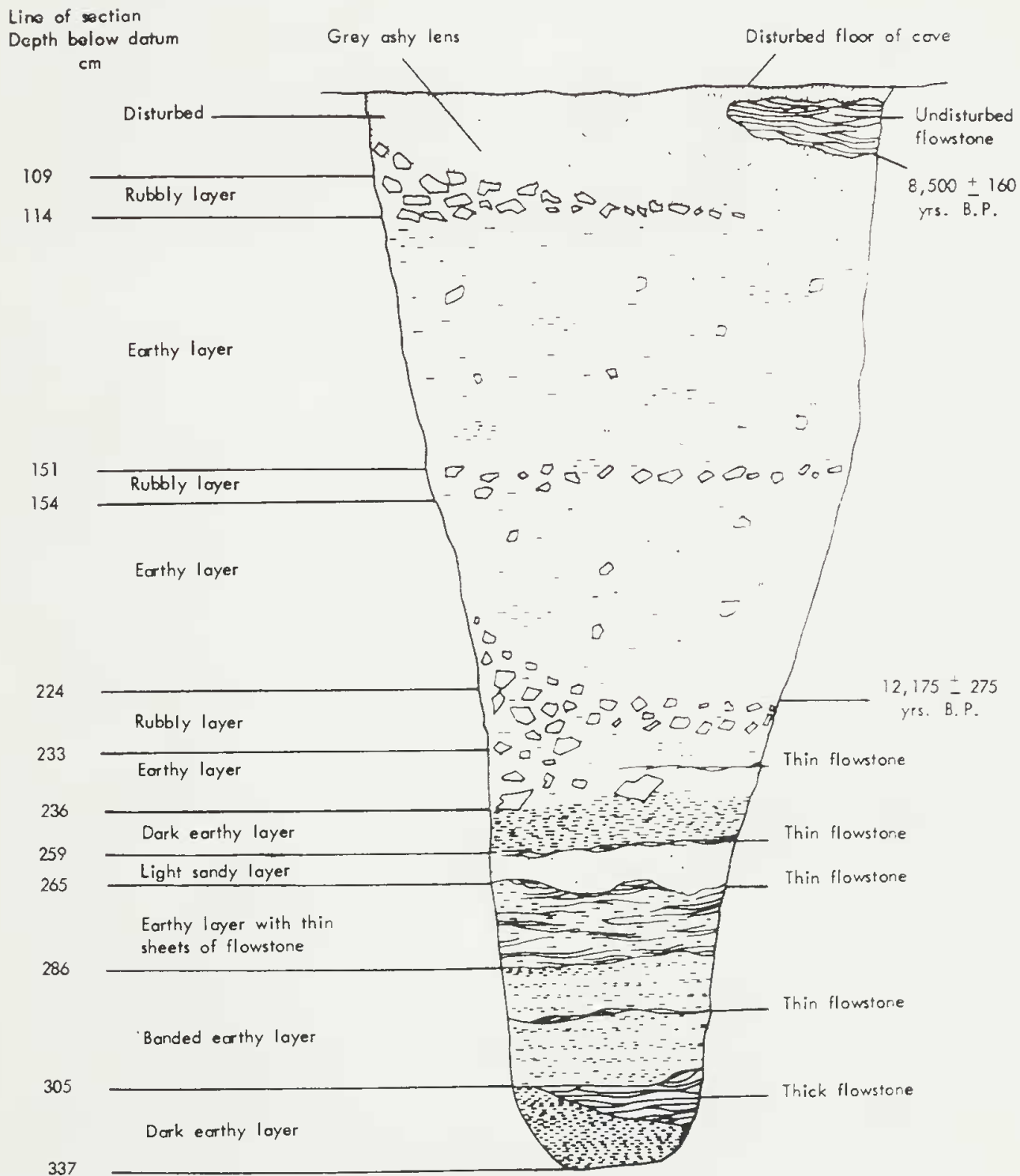


Figure 2.—South west section of undisturbed cave floor deposit, Trench A1, Dortch Excavation, Devil's Lair. The "line of section" depths were measured vertically on the north east face of the trench, and correspond only approximately with the actual depths of the layers shown above. The stratigraphic correspondence of the layers shown with those in the line of section is exact. The approximate stratigraphic positions of the radio-carbon dates reported by Lundelius (1960) are shown on the right.

Fig. 2 summarizes our field observation of the section of undisturbed deposit revealed in the south western corner of our excavation ("Trench A1" in our records) and Fig. 3 shows this corner with the excavation nearing completion. Only in this corner could we obtain vertical faces of undisturbed deposit in which to study the stratigraphy. The irregular outlines of the remainder of the excavation were preserved because we wished to avoid further encroachment on the deposit pending our choice of a suitable position for later systematic excavation.



Figure 3.—Trench A 1, Dortch Excavation, Devil's Lair, showing walls of stratified undisturbed cave floor deposit. The ranging pole shows one foot divisions. The vertical face lying between the ranging pole and the lamp is that represented in Fig. 2. The stalagmite shown separately in Fig. 4 is that shown close to the right hand wall in this photograph. The excavation was carried downward about 70 cm. after this photograph was taken.

We recorded depths below an arbitrary cave datum, in a line of section arbitrarily chosen, and it is these depths which are recorded on the left in Fig. 2 and Table 1, as well as in

our field notes and on the labels of our specimens. Fig. 2 shows a face about 90 cm removed from this line of section. The layers dipped at low angles and there were irregularities in the layer boundaries. Hence the line of section depths do not correspond exactly with the layers shown in Fig. 2.

Age of the Deposit

Two radiocarbon dates are reported by Lundelius (1960) for his excavations in Devil's Lair. Both were determined on charcoal samples. The uppermost sample came from "immediately under the travertine floor" which would correspond stratigraphically to a depth of about 100 cm in our line of section. The date recorded is $8,500 \pm 160$ yrs B.P. (0-654).

Lundelius' lower dated sample came "from a depth of four feet", which would correspond stratigraphically approximately with a rubbly layer extending from 224 to 233 cm deep in our line of section. This date was $12,175 \pm 275$ yrs B.P. (0-658). (Date numbers—E. L. Lundelius, personal communication.)

Lundelius (1960) comments that his dates show "a slow rate of accumulation of sediment within the cave". Alternatively, the lack of change in character noted by Lundelius in the upper part of the deposit, which we confirm, might mean that the sediment accumulated rapidly and that the younger dated sample represents material which accumulated on a surface of long standing, prior to the formation of a thick flowstone. We found no such surface, but the uppermost part of our section was disturbed, presumably by previous collectors burrowing under the flowstone.

There is evidence from the lower part of our excavation of at least one lengthy pause in sedimentation. At a depth of about 208 cm below our arbitrary datum, our excavation in undisturbed material revealed the top of a stalagmite. As excavation proceeded, this stalagmite was uncovered to a depth of 265 cm, where it was found to originate on a thin flowstone (see Fig. 2) marking the top of one of our stratigraphic units, an earthy layer containing very thin discontinuous sheets of flowstone. This layer, and the one below it, down to a depth of about 305 cm below datum, contained ill defined stalagmitic masses directly below the well defined stalagmite described above. It seemed as though a drip system had persisted in the cave for some time. At first, this drip system produced stalagmitic masses some 10 cm in height (e.g. specimen G 13177), but these were buried by incoming "cave earth". A more coherent flowstone than usual then appears to have sealed this earthy layer, and sufficient time appears to have elapsed for the same drip system to produce a stalagmite nearly 11 cm in diameter at its base; this stalagmite (specimen G 13176) is shown in Fig. 4.

TABLE 1

Minimum numbers of individuals of the mammal species and other vertebrates listed, found in situ in Devil's Lair, 1970

Depth below datum in line of section	Approximate stratigraphic position of previously dated samples	Minimum number of vertebrate animals represented per cubic metre of deposit	Species identified																Not specifically identified			Artifacts										
			<i>Dasynus geoffroyi</i>	<i>Phascogale tapoatafa</i>	<i>Antechinus fuscipes</i>	<i>Smithopsis murina</i>	<i>Sarcophilus harrisi</i>	<i>Isodon obesulus</i>	<i>Perameles</i> cf. <i>P. bonguiville</i>	<i>Trichosurus vulpecula</i>	<i>Pseudochelone peregrius</i>	<i>Cercartetus concinnus</i>	<i>Potorous tridactylus</i>	<i>Bellamia penicillata</i>	<i>Bellamia lesueur</i>	<i>Petrogale penicillata</i>	<i>Macropus eugenii</i>	<i>Macropus irma</i>	<i>Macropus fuliginosus</i>	<i>Setonix brachyurus</i>	<i>Pseudomys prueensis</i>	<i>Pseudomys albocinctus</i>	<i>Pseudomys shortridgei</i>	<i>Notomys</i> cf. <i>N. mitchelli</i>	<i>Rattus fuscipes</i>	Bat	Bird	Reptile	Stone artifacts	Bone artifacts		
109 114 151 154	8,500 ± 160 yrs B.P.	1,030	1			1	2	1	1	1	1	2	2	2	2			1	1		1	1			1	3	2	2		p	p	
		350	3		14	2	9	2	4	4			7	13	7	2		2	2	7	7	4	1	1	11	1	1	11		p	p?	
		1,070	1	1	6				1	1	1		2	1	1		2	1	6		2	2	1	1	2		2	2		p	p	
		310	9	1	1	15	2	10	2	9	12	4	3	12	14	7	2	1	6	5	13	13	5	5	20	1	3	2	2		p	p
224 233 236 259 265 286 305 337	12,175 ± 275 yrs B.P.	380	1		4		1		1	1	2		2	1			1	1		1	1			6		1	2			p		
700		1		1	2	1							2	1						1	1	2	1	1								
120		1			3		1		1	2	1		1	1			1	1		1	1	1	1	6				1				
2,040				2	2			1	1	1	2		1					1			2	2	2	17			2	1				
70		1										1		1					1	1	1	1		1			1	1				
280					5		1	1	1	1									1	1	2	1	1		6		1	2				
290			2	3	2		2	1				1						1	1	1	2	2	3		10	2	1	2				
(Bottom not reached)																																



Figure 4.—Stalagmite G 13176 found buried in undisturbed floor deposit, Devil's Lair. Base was part of thin flowstone 265 cm below datum, top was embedded in earthy layer 208 cm below datum. Projecting lip about 11 cm above base represents part of thin flowstone capping same "light sandy layer" as shown in Fig. 2.

This stalagmite grew in stages to a height of 57 cm and when we uncovered it, it received frequent periodic drips, enough to wash the top clean, as shown in Fig. 3. Thus the same drip system appears to have functioned right up to the present day, although it may have been intermittent.

Some mechanism must have prevented the growth of this stalagmite above the 208 cm level. The likely mechanisms appear to be either drying up of the drip system or influx of "cave earth" in sufficient quantity to bury the stalagmite deeply. If the latter, the burial appears to have been rapid because the top of the stalagmite is smoothly rounded and shows no contamination by "cave earth" and because there were no stalagmitic masses in the undisturbed

deposit vertically above G 13176. There may have been stalagmitic masses in the uppermost parts of the deposit prior to its disturbance. Indeed there may have been a stalagmite on the thick flowstone which originally capped the deposit but which was removed before our excavation began.

This interpretation (rapid burial of stalagmite G 13176) reinforces the suggestion made above that the upper part of the deposit may have accumulated rapidly.

We have no data on the rate of growth of stalagmites in Devil's Lair at any given time, and in any case, this rate of growth probably differs at any one time from one point to another only a few centimetres away, presumably depending on the supply of water from the roof. But the growth of a substantial stalagmite may represent some considerable pause in sedimentation in the cave. Perhaps significantly, resumption of sedimentation is marked by our most distinctive stratigraphic unit, a light coloured, sandy layer, conspicuously rich in the remains of small mammals (the layer shown in Fig. 2 as extending from 259 to 265 cm below datum).

We found no other clear evidence of such pauses in sedimentation, but we excavated only a very small volume of undisturbed deposit. It is reasonable to suggest that each flowstone layer revealed in our excavation (see Fig. 2) represented a pause in sedimentation, even though most of these flowstone layers were very thin (about 1 cm thick).

Thus, accepting the dates reported by Lundelius as applying approximately to our excavation, and accepting that each flowstone recorded by us marks some pause in sedimentation, we suggest that the deposit excavated by us represents terminal Pleistocene and early Recent time.

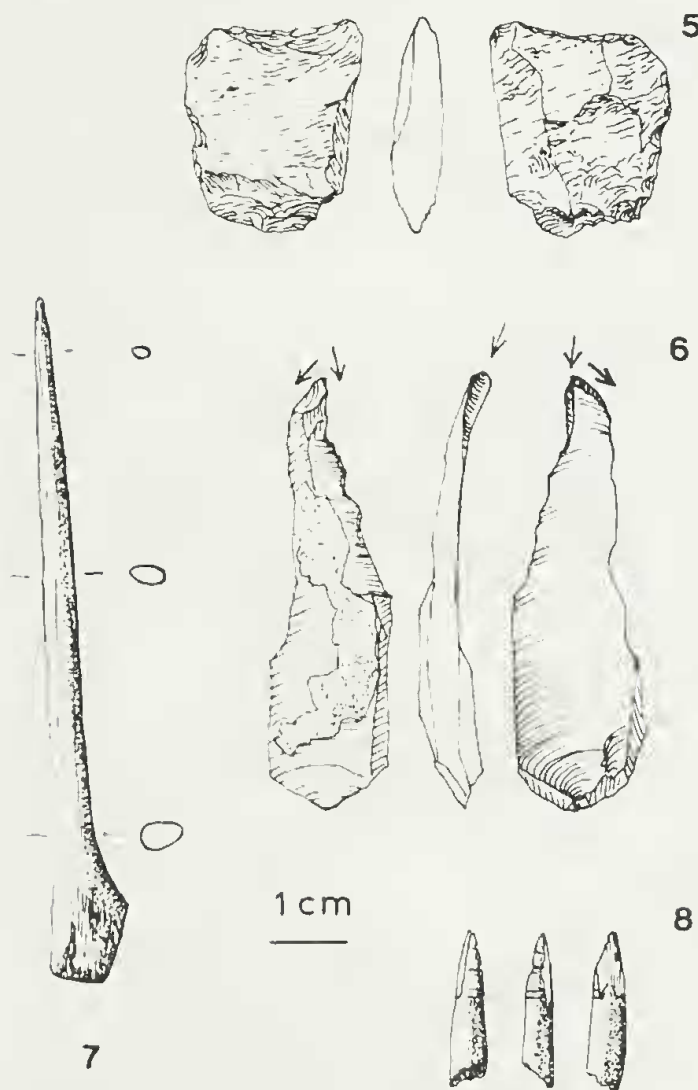
Artifacts

We found stone and bone artifacts, charred bone, fragments of bones which could have been broken by man, and bones and teeth which appear to be artificially incised. This material was confined to the upper 140 cm of the deposit (Table 1). Previous excavators also found such items, including the baler shell and human incisor tooth mentioned by Merrilees (1968b), a fragment of fresh water mussel shell (70.63) collected by D. L. Cook in 1959 or 1960, stone artifacts collected at various times, and the dentary of a rock wallaby (70.6.105) with deep, narrow, transverse cuts on the incisor, collected by K. Pearce-Shorten and others in 1970.

Fourteen chert or quartz flakes were excavated by us from the undisturbed part of the deposit, and six more were recovered by screening the disturbed material. In addition, many fragments of calcrete were recovered, both from disturbed and undisturbed material, which conceivably could be artifacts. Some resemble choppers or rough cores (e.g. A 22018), while others (e.g. A 22007) could be flakes. It is difficult to decide whether or not these calcrete objects are indeed artifacts because most of them have been corroded by ground water.

A quartz flake with bipolar shattering (A 21976), of the type variously referred to in Australia as a fabricator (e.g. by McCarthy 1968) or a scalar core (e.g. by White 1968) and in France as a *pièce écaillée* (e.g. by Sonnevile-Bordes and Perrot 1956) is shown in Fig. 5; this came from undisturbed deposit (150 cm below datum).

No other formal tool types such as geometric microliths, retouched points, scrapers or adze-flakes were recovered by us either in undisturbed or disturbed material from the excavation site, and so far as we know, previous excavators did not recover any such tools. However, we did find a dihedral burin made on a small blade (A 17558a) cemented to the flowstone surface of the cave floor about 3 m from our excavation; this is shown in Fig. 6.



Figures 5-8.—Artifacts from Devil's Lair. 5.—Quartz flake A 21976 with bipolar shattering, from undisturbed deposit about 150 cm below datum. 6.—Burin A 17558a, found cemented to the flowstone floor of the cave near "Small Excavation". 7.—Bone point A 21983, from undisturbed deposit 151 to 154 cm below datum. 8.—Lower incisor A 22025a of a wallaby with transverse incisions; recovered during screening of disturbed material; probably lay about 100 cm below datum.

Bone artifacts include a point or awl about 8½ cm long (A 21983) made from the fibula of a wallaby. This was found *in situ* and is shown in Fig. 7. Historical accounts (Grey

1841 p. 266, Moore 1842 pp. 31-32, 78, Hammond 1933 p. 31) of the use of tooth and bone tools by Aborigines in south western Australia include several uses for which A 21983 would be appropriate. It might have been used to make holes in kangaroo skins preparatory to sewing them together for use as cloaks or bags, or as a toggle to fasten the neck of a skin cloak, or to drill holes in the butts of spears to fit the peg of the spear thrower, or to pierce the septum of the nose to accommodate a nose bone, or as the nose bone itself, or to aid in the extraction of teeth.

Many bone splinters and fragments were smoothly rounded or pointed at the ends, suggesting they might have been used as tools. However, Brain (1967) has shown that "bone pseudo-tools" can be produced from scraps of bone broken by humans, further broken by their dogs, left lying on sandy surfaces, and subjected to trampling by men and goats. It is conceivable that a somewhat similar process could have affected bones in Devil's Lair, broken initially by men, then by dogs or devils, then trodden by men and perhaps by devils or wallabies into sandy surfaces. Consequently we are reluctant to describe most of the bone splinters collected as tools.

However, some of these bone fragments and some wallaby lower incisor teeth carry narrow relatively deep incisions which appear to be man made. For example, wallaby incisor A 22025a, shown in Fig. 8, might have been hafted for use as a tool. Moore (1842 p. 54) reports that among Aborigines in the south west of Western Australia, a large kangaroo incisor sometimes was inserted in the gum handle of a spear thrower "for the purpose of scraping anything, as the points of spears &c." Nind (1832 p. 30), in his description of the butchering of kangaroos by the Aborigines of King George Sound, reports "The first operation is to extract the front teeth of the lower jaw, which they use to sharpen the spear points; . . ."

We know of no historical records for the region of the splitting and smashing of long bones or of the use of such bones or bone splinters as tools, though Ord (1879 p. 10) records that there was much use of kangaroo bone "for domestic purposes". It is possible that some femur fragments from Devil's Lair, such as A 21999 or A 22028a represent deliberate breakages to extract marrow.

Some of the bone fragments from Devil's Lair (e.g. A 21993) are charred, and while such charring might result from bush fires acting on partly decayed carcasses or on bare bones lying outside the cave and subsequently washed in, it is equally likely to result from deliberate cooking of butchered carcasses either outside or inside the cave, or from the burning of bone fragments regarded as refuse, as described by Hammond (1933).

The piece of baler shell mentioned above (Chicago Natural History Museum specimen PE 11150) represents the rather rare gastropod *Cottonia nodiplicata* (Cox, 1910) (B. R. Wilson, personal communication).

We found no human skeletal remains, either in the undisturbed deposit we excavated nor in the disturbed material we screened.

Fauna

Our excavation in undisturbed deposit confirmed what has been suggested from the findings of previous workers, namely that the Devil's Lair deposit is faunistically rich, especially in mammals, but that it contains no examples of the large extinct marsupials such as *Sthenurus* or *Zygomaturus* known from other deposits in the Cape Leeuwin-Cape Naturaliste region, such as Mammoth Cave (Merrilees 1968b) or Labyrinth Cave (Merrilees 1969). Faunistic data for Devil's Lair are set out in Table 1.

There are some differences between the species listed in Table 1 and those listed by Lundelius (1960) and Cook (1960). Some of these are merely differences in name, resulting from the recent reappraisals of species limits noted by Ride (1970), for example our use of *Potorous tridactylus* to embrace specimens formerly assigned to the more narrowly conceived "species" *P. gilberti*. But we differ from Cook (1960) in ascribing our *Sminthopsis* specimens to *S. murina* rather than to *S. crassicaudata* and we add some new records, namely *Antechinus flavipes*, *Cercartetus concinnus*, *Macropus eugenii*, *Notomys* cf. *N. mitchelli* and *Pseudomys praeconis*.

Other additions based on specimens recovered from our screening of disturbed material are noted below.

The most barren layer of undisturbed deposit excavated by us yielded vertebrate remains equivalent to 70 individual animals of all sizes per cubic metre, and the richest layer, 2040 individuals per cubic metre; both of these layers were in the lower part of our excavation. Layers which could be described as "rubbly" were richer in vertebrate remains than the remaining layers which could be described as "earthy". Towards the top of the deposit remains of vertebrates of about the size of the introduced rat (*Rattus rattus*) were present in numbers comparable with vertebrates of larger size; but towards the bottom of our excavation there was a predominance of small animals, in the proportions of about 17 small to 1 large vertebrate in the richest layer. Mammals greatly predominated over other vertebrates at all levels, comprising 75% of the total vertebrate individuals in the most barren layer mentioned above and 94% in the richest. Murids were the most abundant mammals, with at least 230 individuals represented in undisturbed deposit, followed by macropodids (at least 117 individuals) and dasyurids (at least 97 individuals).

Some of the mammal species represented appear to have become extinct in the Cape Leeuwin-Cape Naturaliste region in prehistoric time, though persisting elsewhere in Australia long enough to have left historic records in the form of museum specimens. For example, *Sarcophilus harrisii* (the "Tasmanian" devil) was represented by remains of at least 7 animals, all from the upper parts of our excavation; this species appears to have been confined to

Tasmania in historic time. The most common macropod in the deposit was the rat kangaroo *Bettongia lesueur*, and the next most common was the rock wallaby *Petrogale penicillata*, neither of which is recorded in the Cape Leeuwin-Cape Naturaliste region in historic time, though both species still live elsewhere in Western Australia. Of the two bandicoot species represented in the deposit, the more common was the short nosed bandicoot (*Isodon obesulus*) which still lives in the region. The less common species in the deposit (a species of long nosed bandicoot, *Perameles*) is not known from the region in historic time, though it or a similar species still persists elsewhere in Western Australia, and it is known from other fossil deposits in the region (Merrilees 1968a). The number of individuals of *Macropus fuliginosus* entered in Table 1 may be too high, as the large bones of one animal may have become distributed over several layers by what White (1970) calls "treadage and scuffage".

Most mammal species present at all were present at most levels in our excavation, as shown in Table 1. However, trends were discernible in the depth and therefore age distributions in a few species. *Antechinus flavipes* was present in small numbers, but only in the lower parts of the deposit, as also was true of *Cercartetus concinnus* and *Potorous tridactylus*. On the other hand, *Sarcophilus harrisii*, *Macropus eugenii* and *Macropus irma* were present in small numbers but only in the upper parts of the deposit. *Petrogale penicillata* was well represented in the upper but not present in the lower part of the deposit; this species is not recorded from the older Mammoth Cave deposit (Merrilees 1968b), so it would appear to have arrived in the region before 12,000 years ago, but not long before.

It is difficult to infer climatic changes from the few cases of changing faunal distribution with depth in our excavation, and it seems likely that chance plays some part in the distribution. For example, the total number of specimens of *Potorous tridactylus* is so low (representing perhaps 4 individuals) that its absence from the upper parts of the deposit may have no great significance, especially since its remains are common in the surface litter of bones present in other caves nearby. Indeed, it is the paucity of *Potorous* specimens that requires explanation rather than their absence from particular levels. Some of the *Potorous* specimens (e.g. 70.12.791) are small relative to specimens from other caves in the region. Another species represented only by very small numbers (4 individuals) is *Phascogale tapoatafa*, and this is present both in upper and lower parts of the deposit.

Table 1 lists a seemingly incongruous mixture of species like *Bettongia lesueur*, *Perameles* cf. *P. bougainville*, *Pseudomys albocinereus* and *Notomys* cf. *N. mitchelli* which in historic time appear to have been typical of rather dry environments, and others like *Potorous tridactylus*, *Setonix brachyurus* and *Pseudomys shortridgei* apparently more characteristic of wetter environments. Some of this seeming incongruity may

arise from the geographical setting of Devil's Lair. At present, and perhaps in the past, the cave lies near a boundary between forest and a coastal zone of heath-like and shrubby vegetation on sand dunes. Even the forest is not uniform, part of it growing on laterite deposits shallowly mantling the crystalline basement rock, and part of it growing on a thicker mantle of "Coastal Limestone". Running streams and permanent swamps occur in the former parts, while the latter are characterized by sub-surface drainage.

Thus one would expect a sample of the mammals living within a few kilometres of Devil's Lair at present to include representatives of rather dry and rather wet environments. Some of the specimens mentioned below, however, seem to go beyond this expectation and to suggest that there were phases of drier and perhaps warmer climate during accumulation of the deposit excavated.

Cook (1960) records the ghost bat (*Macroderma gigas*—specimen 60.10.21) from the upper part of the deposit; this species appears to have lived only in arid or tropical parts of Australia in historic time (Ride 1970), and the nearest locality of any specimen, fossil or modern, in the Western Australian Museum collection, is in the Wanneroo district, near Perth (specimen 68.5.9).

Our record of *Notomys* is the only record of this genus, modern or fossil, for the Cape Leeuwin-Cape Naturaliste region, despite the fact that caves are numerous, and surface litter in many caves and excavations in some have yielded abundant fossil and sub-fossil remains (Merrilees 1968b). We found specimens *in situ* representing at least 9 individuals of *Notomys* cf. *N. mitchellii*, and additional specimens in disturbed material, so that possibly the occurrence has some climatic significance. It may indicate drier conditions at some time in the past than obtain now.

A small fragment of the dentary of a very young animal (70.12.1132) found by us in disturbed material has not been identified with confidence, but may represent the brown hare-wallaby *Lagorchestes leporides*. This is recorded in historic time from western New South Wales, eastern South Australia, and north western Victoria (Ride 1970).

A single worn canine tooth (70.12.202), also found in disturbed material, appears to represent the dingo (*Canis familiaris*). Unless this specimen came from surface litter accidentally incorporated in the excavated material its age is apparently no less than about 8,500 years, making it the oldest record of the species for the whole continent (cf. McCarthy 1970).

In addition to the mammal remains described above, those of bats, small birds, lizards, snakes, snails and insects were recovered during our excavations, but except for the snails (see below) have not been examined in detail.

Discussion

We have no doubt that the Devil's Lair deposit has an archaeological component, at least in the upper parts excavated, and it may prove

to be of considerable archaeological interest when an adequate sample of undisturbed material can be excavated carefully.

The undisturbed material excavated by us was too small in volume to enable us to decide whether the deposit represents a human occupation site or whether the artifacts were washed in or brought in by devils, emus or other animals. We found no waste material from stone working in the area excavated, but this area was at the back of the cave and may never have received enough light for stone working to be carried out. On the other hand the cave may have served as a temporary camp for use in bad weather or by groups engaged in some specialized activity.

The absence of geometric microliths and backed blades is worthy of note. Surface finds of these tools in areas immediately to the north and east of the Cape Leeuwin-Cape Naturaliste region indicate that geometric microliths and backed blades were used in south western Western Australia in times unknown. Neither of these tool forms is known to occur in the Cape Leeuwin-Cape Naturaliste region. This absence may be due as much to the lack of systematic collecting of surface material as to a real absence of those tool forms in this area. At the same time, if one refers to the dating sequences of the industrial developments in other parts of Australia (e.g. Mulvaney 1969, Lampert 1971, Lampert in Mulvaney and Golson 1971), their absence from a deposit which is apparently at least eight thousand years old could indicate that the site was occupied prior to the development or the introduction of these tool forms in the region.

Devil's Lair is at present nearly 5 km from the sea shore, and the excavated parts of the deposit apparently represent times of lower sea level and an even more distant shore line than the present. Thus it is not surprising that remains of fish, marine mammals and marine shellfish have not been found in the deposit, except for the piece of baler shell mentioned above, which may be the remains of a water carrier, not of an item of diet. Possibly the Aborigines whose artifacts were found in Devil's Lair did include marine animals in their diet, but if so, did not transport them as far inland as Devil's Lair. However, it is also possible that these people did not normally eat marine animals.

The faunal remains listed for the upper part of the deposit, which also yielded artifacts, are consistent with the view that they represent Aborigines' food remains. Kangaroos, wallabies, possums, rats and lizards are all recorded as foods favoured by Aborigines in the south western part of Western Australia at the time of the European occupation (Grey 1841).

According to Lundelius (1960, 1966) the upper part of the deposit excavated by him represented the floor deposit of a *Sarcophilus* den on two of his major criteria (presence of *Sarcophilus* remains and presence of remains which can reasonably be ascribed to *Sarcophilus* prey). The third of his criteria (presence of coprolites

which could reasonably be ascribed to *Sarcophilus* subsequently has been met also, for example in specimen 68.4.171.

Nevertheless we suggest that the bone component of the deposit is not entirely, perhaps not primarily, the leavings of *Sarcophilus*, but at least in part the leavings of man. Both *Sarcophilus* and man were present in the area, both take small and medium sized animals as prey, and both leave behind broken bones. But in addition, man may be expected to include some of the larger mammals such as *Macropus irma* (the western brush wallaby) or *M. fuliginosus* (the western grey kangaroo) as prey, and to leave behind bone fragments charred in cooking fires, either during the cooking process or after the bone fragments were discarded. It is possible that *Sarcophilus* as it is represented in the Devil's Lair deposit, was prey, not predator.

We have no certain evidence of charring of *Sarcophilus* bones, but numerous fragments of other bones were charred, and readily identifiable fragments of three mammal species were so charred (*Bettongia penicillata*, *Trichosurus vulpecula* and a large *Macropus* presumably *M. fuliginosus*—specimens A 22114-6 respectively).

Guiler (1970) suggests that devils (*Sarcophilus*) at present "live successfully in close contact with human settlement and activity . . .", and they may have been scavenging camp followers of the Aborigines, at least before the introduction of the dog. Thus Devil's Lair might have served intermittently as the camp site of an Aboriginal group visited from time to time by scavenging *Sarcophilus*, but at which captured *Sarcophilus* individuals were occasionally cooked and eaten. In the intervals between successive human occupations, it might have served as a *Sarcophilus* lair. It might not be easy to choose between these alternatives even after large scale, systematic excavation of the deposit.

We suggest that the upper part of the deposit, including all that excavated by Lundelius, represents, in part, food remains and other debris of human predators. Artifacts do not occur in the lower parts of the deposit excavated by us, nor does *Sarcophilus*. It is in these lower parts that small mammals greatly predominate over large ones. Some other smaller predator appears to be involved in the lower parts of the deposit, and this might be *Sarcophilus* or *Dasyurus* or an owl such as the masked owl (*Tyto novaehollandiae*) which still occurs in the region (Mees 1963). *Dasyurus* or *Tyto* individuals initially occupying the cave may have been driven out later by *Sarcophilus*, permanently or intermittently. Again, if *Sarcophilus* or *Canis* arrived late in the region, they might have altered the relative abundance of various prey species. If a predator as small as an owl was responsible for most of the small mammal remains at any level, some other agency must have been responsible for remains as large as those of *Macropus fuliginosus*.

The deposit appears to us to comprise mainly material washed or fallen into a cavity which was once much larger than the existing one.

If this is so, remains of large animals dying or being killed outside the cave might well become mixed with remains of small animals accumulating beneath an owl roost in the cave. Indeed, such processes might have continued throughout the time of deposition, with intermittent occupation by human beings and/or "Tasmanian" devils in the later stages.

Further support for the concept of human occupation of the area comes from a consideration of the land snail remains recovered. Shells of *Austrosuccinea* and *Luinodiscus* were abundant, but those of the larger *Bothriembryon* were uncommon, a quite different situation from that in the nearby Strong's Cave, which could never have been easily accessible to human visitors. *Bothriembryon* is at present common in dolines in the Cape Leeuwin-Cape Naturaliste region, but less common on the surrounding forest floor. Disturbance of the topsoil and the vegetation of the doline by human trampling, digging and burning would militate against *Bothriembryon* much more than against the smaller *Austrosuccinea* or the tiny *Luinodiscus* which could continue to occupy rocky recesses in the walls of the doline (G. W. Kendrick, personal communication).

If the upper parts of the deposit do indeed represent the refuse of human groups, and do not contain remains of *Sthenurus*, *Zygomaturus* and other such large animals, then presumably these large animals had already become extinct in the region, as Jones (1968) has postulated.

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References

- Brain, C. K. (1967).—Bone weathering and the problem of bone pseudo-tools. *The South African Journal of Science* 63: 97-99.
- Cook, D. L. (1960).—Some mammal remains found in caves near Margaret River. *The Western Australian Naturalist* 7: 107-108.
- Davies, P. L. (1968).—An 8,000 to 12,000 years old human tooth from Western Australia. *Archaeology and Physical Anthropology in Oceania* 3: 33-40.

- Grey, G. (1841).—"Journals of two expeditions of discovery in north-west and western Australia during the years 1837, 38 and 39." (Boone, London, 2 volumes.)
- Guiler, E. R. (1970).—Observations on the Tasmanian Devil, *Sarcophilus harrisi* (Marsupialia: Dasyuridae). *Australian Journal of Zoology* 18: 49-70.
- Hammond, J. E. (1933).—"Winjan's people. The story of the South-West Australian Aborigines." (Imperial Printing Company, Perth.)
- Jones, R. (1968).—The geographical background to the arrival of man in Australia and Tasmania. *Archaeology and Physical Anthropology in Oceania* 3: 186-215.
- Lampert, R. J. (1971).—Burrill Lake and Currarong. *Terra Australis* I (Canberra: Dept. of Prehistory, A.N.U.)
- Lundelius, E. L. (1960).—Post Pleistocene faunal succession in Western Australia and its climatic interpretation. *Report of the International Geological Congress, XXI Session, Norden 1960 Pt IV Chronology and climatology of the Quaternary.* 142-153.
- Lundelius, E. L. (1966).—Marsupial carnivore dens in Australian caves. *Studies in Speleology* 1: 174-180.
- McCarthy, F. D. (1967).—'Australian aboriginal stone implements.' (The Australian Museum, Sydney.)
- McCarthy, F. D. (1970).—Australia: 1964-1966 (Regional Report). *Asian Perspectives* 10: 137-159.
- Mees, G. F. (1963).—Status and distribution of some species of owls in Western Australia. *The Western Australian Naturalist* 8: 166-169.
- Merrilees, D. (1968a).—Fossil bandicoots (Marsupialia, Peramelidae) from Mammoth Cave, Western Australia, and their climatic implications. *Journal of the Royal Society of Western Australia* 50: 121-128.
- Merrilees, D. (1968b).—Man the destroyer: late Quaternary changes in the Australian marsupial fauna. *Journal of the Royal Society of Western Australia* 51: 1-24.
- Merrilees, D. (1969).—A newly discovered bone-bearing deposit in Labyrinth Cave, near Augusta, Western Australia. *The Western Australian Naturalist* 11: 86-87.
- Moore, G. F. (1842).—"A descriptive vocabulary of the language in common use amongst the aborigines of Western Australia." (London.)
- Mulvaney, D. J. (1969).—"The prehistory of Australia." (Thames and Hudson, London.)
- Mulvaney, D. J. and Golson, J. (Editors) (1971).—"Aboriginal man and environment in Australia." (Australian National University Press, Canberra.)
- Nind, S. (1832).—Description of the natives of King George's Sound (Swan River Colony) and adjoining country. *The Journal of the Royal Geographical Society of London* 1: 21-51.
- Ord, H. St. G. (1879).—"A brief account of the natives of Western Australia . . ." (Perth, Government Printer.)
- Ride, W. D. L. (1970).—"A guide to the native mammals of Australia." (Oxford University Press, Melbourne.)
- Sonneville-Bordes, D. de and Perrot, J. (1956).—"Lexique typologique du paléolithique supérieur. Outillage lithique . . . Pièces variées", *Bulletin de la Société Préhistorique Française*, 53: 547-559.
- White, J. P. (1968).—Fabricators outils écaillées or scalar cores." *Mankind* 6: 658-666.
- White, J. P. (1970).—(Review of book by C. B. M. McBurney.) *Mankind* 7: 326-327.